# Exchange visit to SCK•CEN (Belgian Nuclear Research Centre)

Mol, 25th-29th March 2024

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Thanks to the PIANOFORTE travel grant, I was able to organize an exchange visit to the Radiation Protection Dosimetry and Calibration Group at SCK CEN, the Belgian Nuclear Research Centre in Mol, from 25th to 29th March 2024. The main focus of this visit was to deepen my knowledge on the latest tools for developing occupational dosimetry applications based on human pose tracking and computer simulations, to be used when physical dosimeters are inadequate or unavailable.

On the first day, I shared with the group my experience at ISS on online computational dosimetry for Nuclear Medicine workers, showing them the issues to be addressed in terms of 3D reconstruction accuracy of worker poses when using low-cost RGB cameras, and validation of Monte Carlo or deterministic radiation dose calculations with experimental measurements for I-131 and Lu-177 sources.

In the following days, the group introduced me to their main activities on the topic. In particular, they gave me an overview of the PODIUM project, where they first applied the novel approach of computational personal dosimetry to assess the exposure of the staff in Interventional Radiology settings. I gained knowledge on several technologies involved in the creation of the geometry input file for Monte Carlo simulations, such as: 1) the 3D modelling of flexible and realistic human phantoms based on polygonal meshes; 2) advanced depth cameras for skeleton-pose tracking and 3D reconstruction, which can be used to animate the realistic phantoms; 3) laser scanning for an accurate workplace geometry definition. I was then introduced to the ANUBIS project, where a similar computational dosimetry framework has been used to develop an ALARA planning and training tool for dismantling and disposal purposes. They showed me how to compute and visualize the 3D radiation field by making use of different interpolation methods on Geant4 simulation data. Finally, they presented to me an ongoing project on extremity dosimetry for staff in Nuclear Medicine, where different CNN-based algorithms have been used to track the hand pose during the preparation and administration of radiopharmaceuticals and trained to detect the position of the syringe containing the radioactive material.

Over the last two days, I had the opportunity to test their computational dosimetry workflow first hand, by recreating in a CAD environment the real scenario of a measurement set-up I performed in a Nuclear Medicine therapy room with a point source of I-131 and an ambient dosimeter. I was able to write an input file for the Geant4 ANUBIS tool and run a simulation to compute the dose deposited

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in the detector. The results showed good agreement with the measurements and previous calculations with deterministic codes, a valuable result for the validation of my computational dosimetry system. I also had some practice in modelling a simple MIRD phantom and realistic human organs on the open source 3D computer graphics software Blender, which will be very useful for simulating routine Nuclear Medicine patient therapy scenarios to assess the dose to caregivers.

This visit was a very inspiring experience and will certainly have a positive impact on the future development of my research. I came home with many valuable insights, new contacts and a greater awareness of recent advancements in radiation protection and computational dosimetry. Moreover, it was a great opportunity to engage with one of the foremost research groups in this field. Their expertise, availability and help have been significant, and I look forward to establishing a collaborative project to progress together in computational dosimetry in Nuclear Medicine.

I really appreciate PIANOFORTE partnership for this precious initiative of travel grants, and I recommend to every young radiation protection professional or researcher to apply for this support.

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